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Use IT again? Dynamic roles of habit, intention and their interaction on continued system use by individuals in utilitarian, volitional contexts

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ABSTRACT

This paper employs a longitudinal perspective to examine continued system use (CSU) by individuals in utilitarian, volitional contexts when alternative systems are present . We focus on two key behavioural antecedents of CSU – habit and continuance intention – and theorise how the relationships between CSU and these antecedents evolve over time. In addition, we hypothesise how the interaction effect of habit and intention on CSU evolves temporally. Our theorising differs from extant literature in two important respects: 1) In contrast to the widespread acceptance of the diminishing effect of continuance intention on CSU in the information systems (IS) literature, we hypothesise that in our context, its impact increases with time; and 2) In contrast to the negative moderation effect of habit on the relationship between intention and CSU proposed in the literature, we posit a positive interaction effect. We collect longitudinal survey data on the use of a higher education IS from students in a European university. Our results suggest that the impact of continuance intention on CSU as well as the interaction effect between habit and intention are increasing over time. We further introduce a methodological innovation – the *permutation approach* to conduct the multi-group analysis with repeated measures – to the literature.

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Continued system use; habit; longitudinal research; continuance intention; volitional; utilitarian

1. Introduction

Continued system use (CSU) by individuals, characterised by the sustained utilisation of an information system (IS), remains a phenomenon of enduring interest among managers and researchers (Ahuja & Thatcher, 2005; Benlian, 2015; Burton-Jones & Grange, 2013; Kim, 2009; Ortiz de Guinea & Markus, 2009; Polites & Karahanna, 2012, 2013; Veiga et al., 2014; Venkatesh et al., 2008). Two key insights have emerged from this literature. First, IS continuance intention is a vital antecedent to IS use, but may be insufficient to explain long-term use behaviour (Ortiz de Guinea & Markus, 2009). Second, habit can significantly influence continued IS use by individuals (Bhattacherjee & Lin, 2015; Kim & Malhotra, 2005; Limayem et al., 2007). Researchers suggest that when a behaviour is performed for the first time, its execution is achieved largely consciously, however, if a behaviour is performed repeatedly, the execution requires less wilful control (Limayem et al., 2007; Venkatesh et al., 2012). The more recent research in this domain has examined the joint impact of continuance intention and habit on CSU. This literature has converged on two positions. First, over time, continuance intention becomes less important in use behaviour, as habit becomes the more dominant mechanism. Second, habit has a negative moderating effect on the relationship between continuance intention and system use (see, e.g., Bhattacherjee & Lin, 2015; Limayem et al., 2007). However, it is unclear whether these findings are valid across all IS use contexts. We question the consensus in extant research because in widely prevalent IS use contexts which have not been examined in the literature, we posit that these results may not apply.

In this paper, we study an interesting context of utilitarian, volitional use of systems by users that is common in practice yet has been insufficiently theorised and empirically examined in the literature. Consider a situation where people use a variety of systems, with different login routines and interfaces, to complete related tasks. This situation can arise if users must use several systems to accomplish their work-related tasks. Now imagine a new system is introduced that combines functionalities of the previous systems and enables users to get tasks done seamlessly, with uniform user interface and login routines. The use of the new system is volitional; users can continue using the earlier systems, with no enforced

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termination. Some users, upon hearing about the new system through official announcements and informal sources, and encouragement by the organisation, are likely to try it and transition. These users will still have the choice to use the new system or the old system or both systems. Such parallel system implementation scenarios, where multiple systems are used in an organisation, can last from a few weeks to over a decade. For instance, SAP HANA has been available since 2010 and SAP S4/HANA, the biggest leap in enterprise technology from SAP, since 2015. Organizations that have been running prior versions of SAP (e.g., SAP R3) and other enterprise technologies can continue to do so in parallel with SAP S4/HANA at least till 2025.0F[1] These implementation scenarios, where multiple systems are available and users volitionally use one to get tasks accomplished, are common in real-world organisations. For instance, in a study examining ERP implementation, Ehie and Madsen (2005) find that 36 percent of responding organisations employ the parallel implementation approach. However, extant research has largely focused on single system use situations (Lin et al., 2021; Venkatesh et al., 2016). Thus, in order to represent the organisational reality more realistically, to theorise continued system use more deeply, and to provide more relevant suggestions to practitioners, it is vital that we investigate the above-mentioned usage situations thoroughly in a longitudinal manner (Ho et al., 2020; Lin et al., 2021; Valacich et al., 2018).

The reference literature in psychology, which much of the IS use literature draws upon, takes a more fine-grained approach to theorising the effects of continuance intention and habit on use behaviour. It suggests that the individual and joint effects of continuance intention and habit on use behaviour are context dependent. These effects can be positive or negative contingent on the circumstance of the use behaviour. Accordingly, there might be IS use contexts in which habit and intention both remain important or even have a joint effect on system use that is reinforcing (Ouellette & Wood, 1998; Verplanken et al., 1998; Wood & Neal, 2007).

A second consequential aspect we emphasise is that although system use is not a one-time event – it unfolds longitudinally – IS research does not adequately address temporal progression in the relationships between predictors and CSU (Bagayogo et al., 2014; Kim, 2009), which is detrimental to longitudinal theorising of the phenomenon. To explore such effects, longitudinal theorising and research design are required (Bhattacherjee & Premkumar, 2004; Zheng et al., 2014). From a pragmatic perspective as well, it is crucial to investigate how intention and habit, in isolation and in combination, impact system use over time. Such insights can provide pointers to managers to focus on intention and/or habit during the initial and later stages of system use and to make corresponding efforts and investments that are likely to encourage intentional and/or habitual use of the system (Turel, 2015).

In order to extend prior research in IS use, we examine CSU in the *context of a utilitarian system whose use is volitional* due to the presence of alternative systems, which makes longitudinal study of CSU insightful. We draw upon Triandis (1975, 1977) theory of interpersonal behaviour (TIB). We use partial least squares structural equation modelling (PLS-SEM)-based longitudinal models to analyse differences in systems use at different time periods. We test for differences between models over time by employing a novel multi-group analysis (MGA) using an adaptation of the permutation approach to repeated measures (longitudinal data), which is a *new technique* being introduced to the IS literature. Our results suggest that in the context of volitional use of a utilitarian IS, habit is significantly related to CSU, but its impact does not change statistically with time. We further find that continuance intention is significantly related to CSU and its impact increases statistically with time. Finally, we find that the interaction between intention and habit is not significant in the beginning but becomes an important predictor of CSU over time.

This paper makes three significant contributions to the IS literature. First, we examine system use over time in an important context that has not received significant attention in prior literature, accounting for longitudinal impacts of habit, continuance intention and their interaction on CSU. We explicitly theorise how these relationships evolve temporally. To our knowledge, this is among the first studies to provide a longitudinal theorising of CSU, with both continuance intention and habit as antecedents. We model the interaction between intention and habit, an oft-mentioned but insufficiently theorised concept in the IS literature. Second, we challenge extant wisdom in the literature that intention and habit interact negatively and the effect of intention on use reduces over time. We posit that in widely prevalent use situations – when a new system is introduced that combines features of prior systems, yet when its use is volitional – insights obtained from prior research may not be germane. Third, methodologically, we introduce to the IS literature a non-parametric, PLS-based multi-group analysis for dependent samples based on the permutation approach. This approach to MGA enables researchers to assess the evolution of strengths of different relationships across time, surveying a group of respondents multiple times, with some non-response in each round, which is common in the literature. Thus, we believe this analysis will be helpful to IS researchers in analysing longitudinal survey data.

2. Theory development

IS literature examining the adoption and use of information systems is robust and mature. For a synthesis of this literature, we point the reader to reviews (Petter et al., 2008), meta analyses (Petter & McLean, 2009; Wu & Lederer, 2009) and a *MIS Quarterly* research curation (Burton-Jones et al., 2020). In this study, our focus is on the interplay of continuance intention, habit and CSU. Thus, we first synthesise the prior work at the intersection of continuance intention, habit and CSU. Next, we introduce the larger nomological network within which our key study constructs are embedded. Subsequently, we discuss the theory of interpersonal behaviour (TIB) by Triandis (1975, 1977). Finally, based on the theoretical background presented here and our study context, we develop our research model and theorise temporal effects of habit and continuance intention on CSU in a utilitarian, volitional context of IS use.

2.1. Continuance intention, habit, and CSU

Continued IS use is as an important research area in the IS literature (Ahuja & Thatcher, 2005; Burton-Jones & Straub, 2006; Jasperson et al., 2005; Ortiz de Guinea & Markus, 2009). The key defining characteristic of this research is that it refers to behavioural patterns reflecting protracted usage of a particular IS over time (Limayem et al., 2007). A noteworthy development in the literature has been a recent focus on habit, in addition to behavioural intention, to examine IS use. This literature examines the key role habit plays in use behaviour (for a review of the related work around habit, continuance intention and continuance behaviour in top IS journals, please see Appendix A). Researchers conceptualise IS habit as both independent and moderating constructs. As an independent construct, habit positively influences CSU (see, e.g., Khansa et al., 2015; Kim, 2009; Soror et al., 2015). As a moderator, habit *decreases* the strength of relationship between behavioural intention and use (see, e.g., Bhattacherjee & Lin, 2015; Kim & Malhotra, 2005; Limayem et al., 2007). It is important to note that most of these studies use cross-sectional designs, except a few that either combine cross-sectional and longitudinal designs, or rely solely on longitudinal designs (see, e.g., Khansa et al., 2015; Kim & Malhotra, 2005; Kim, 2009).

In sum, extant research presents habit and intention as two alternative, sometimes interacting, mechanisms to explain CSU. Further, extant studies theorise that continuance intention becomes increasingly less important for CSU as time passes and the interaction between continuance intention and habit has a negative effect on use behaviour (Ferratt et al., 2018). This, however, may not be true for volitional use of a utilitarian system when users have other options to get tasks completed. Additionally, studies examining the evolving nature of relationship between habit, behavioural intention and CSU are lacking in the literature. This is evident by a comparison of our study with the four most related studies in IS literature that also look at the impact of habit and behavioural intention on usage behaviour in a single model (see Table 1).

The comparison shows that the studies presented in Table 1 focused on cross-sectional research designs, oftentimes using multiple surveys but without taking a longitudinal perspective. Furthermore, these studies focused on a single system or a general purpose technology, such as the world wide web (Limayem et al., 2007). In other words, these studies did not consider a utilitarian system (except Bhattacherjee & Lin, 2015) or a context where alternative systems are available to get tasks accomplished. Even in Bhattacherjee and Lin (2015), the users could either use the system or stick to a traditional, paper-based process. Thus, the context examined in this study is different from those that have examined continuance intention and habit together. We hasten to mention that two prior studies have examined the particular context we examine (see, e.g., Hong et al., 2011; Polites & Karahanna, 2012). Nevertheless, our work is unique in that it: a) focuses on the interplay of habit, continuance intention and CSU, b) applies a longitudinal research design, and c) studies the context of the introduction of a novel system in parallel to an existing utilitarian system.

Consequently, our approach for advancing IS literature has three pillars: 1) We draw upon TIB which considers both intention and habit as immediate antecedents of behaviour as theoretical lenses to explain CSU over time; 2) We expressly hypothesise how the nature of relationship between habit and CSU, intention and CSU and joint effect of intention and habit on CSU evolve over time in use contexts that are common but underexplored and undertheorized; and 3) We take a more nuanced view of IS use behaviour and hypothesise relationships that go against the established wisdom.

2.2. Nomological network of continuance intention, habit, and CSU

Although the focus of our study is on the interplay of continuance intention, habit, and CSU over time, we deem it important to not study the three constructs in isolation. As discussed previously, there is extensive scholarly research on IS adoption and use. Consequently, numerous studies have investigated different factors impacting key constructs in this research area. To account for this rich set of theoretical insights, without diluting our key research interest, we

Table 1. Comparison of our study with the four most related is studies.

Study	Study Context	Role of Intention and/or Habit	Theoretical Foundation	Research Setting	System Type	Key Results
Limayem and Hirt (2003)	Utilitarian & mandatory	Intention and habit are hypothesised as two independent predictors of actual usage behaviour	Theory of planned behaviour (TPB) & Triandis' model	Cross-sectional	Single system	Intention and habit were shown to be significant predicators of actual usage behaviour
Limayem et al. (2007)	General purpose & volitional	Habit moderates the influence on intention such that its importance in determining behaviour decreases.	IS continuance model	Cross-sectional	Single general purpose technology	The empirical results showed support for the hypothesised negative moderation effect of habit
Venkatesh et al. (2012)	General purpose & volitional	Habit is hypothesised as predictor of both, behavioural intention and use behaviour	Unified theory of acceptance and use of technology (UTAUT)	Cross-sectional	Single general purpose technology	Habit was shown to be a significant predictor of both constructs
Bhattacherjee and Lin (2015)	Utilitarian & volitional	Habit is hypothesised as predicator of continuance behaviour as well as a negative moderator of the influence of continuance intention on behaviour	Expectation-confirmation model of IT continuance & TPB	Cross-sectional	Single system	The empirical results showed support for the hypotheses
This study	Utilitarian & volitional	The hypothesis is that both, importance of intention as well as the importance of habit on usage behaviour will increase over time. Additionally, both constructs are hypothesised to have a joint positive effect on use behaviour over time.	Theory of interpersonal behaviour	Longitudinal	New system being introduced in parallel to legacy systems	The results showed support for the increasing importance of intention as well as for the joint positive effect over time. However, habit already started on a high level and did not change over time.

Table 2. Constructs of the nomological network.

Antecedents	Source
Antecedents of continuance intention	
Social influence	Limayem and Hirt (2003), Venkatesh et al. (2003), Venkatesh et al. (2012)
Perceived usefulness	Limayem et al. (2007), Hong et al. (2011)
Positive affect	Limayem and Hirt (2003)
Antecedents of habit	
Past use	Limayem et al. (2007), Wilson et al. (2010)
Functionality	Baptista (2009)
Perceived ease of use	Baptista (2009)

decided to embed our constructs of interest into the IS use nomological network. This step is essential to ensure that our study has nomological validity (see, e.g., Cronbach & Meehl, 1955; MacKenzie et al., 2011) Additionally, this step demonstrates clearly the key constructs and relationships examined in the literature and allows us to focus on a specific part of the nomological network. It is important to note that the constructs and relationships shown in the nomological network are grounded in prior research, and not at the core of our research. Thus, we include them in our research model, but we do not engage in any theorising around these constructs.

Specifically, we added three antecedents each for habit and for continuance intention to our research model to embed our constructs in a meaningful nomological network. Table 2 provides a summary of constructs that shape our nomological network.

2.3. Theory of interpersonal behaviour

The TIB is a general-purpose theory. The theory suggests that the probability of a behaviour depends on habits and intentions of an individual, and conditions facilitating the behaviour (Triandis, 1975, 1977). However, the influence of habit and intention on behaviour varies based on previous experience. For new behaviour, only the intention to behave is relevant, but the more often a behaviour is repeated, the greater the influence of habit for subsequent behaviour. Triandis (1975) confesses that his model is complex and difficult to implement in totality. He emphasises that predictors should be adapted to the context, and the model should be adjusted in line with the results obtained. He suggests insignificant predictors be dropped. Further, Triandis (1975) recommends that relationships between predictors and the behaviour be examined dynamically to evaluate if the relationships change with time. This last point is particularly significant for us because our study is focused on longitudinal use of a system.

The TIB is an apt theory for our context because it explicitly links habit and intention to use behaviours. Indeed, IS researchers have drawn upon TIB and conceptualised CSU as a frequently performed behaviour. An initial test of TIB to explain system use was conducted by Thompson et al. (1991), who considered social factors, affect and facilitating conditions to explain the utilisation of personal computers – a general-purpose technology – at work. They did not include habit as an antecedent, arguing that habit, conceptualised as the frequency of occurrence of behaviour, is identical to utilisation, potentially leading to a tautology. Cheung et al. (2000) used the same model to explain Internet/World Wide Web – again, a general-purpose technology – usage at work. Both, Thompson et al. (1991) and Cheung et al. (2000) employed *cross-sectional research designs*. Further, neither study examined the influence of habit on the system use behaviour, because in a cross-sectional study, habit and actual behaviour are challenging to distinguish (Cheung et al., 2000). The more recent studies investigating system use have included habit as a predictor (Limayem & Hirt, 2003; Venkatesh et al., 2012). For instance, in their study examining the use of Internet-based communication technology, Limayem and Hirt (2003) used a subset of TIB constructs, including habit, intention to use, and facilitating conditions, as well as antecedents of intention to use, such as affect, perceived consequences and social factors.

In sum, these studies indicate that prior research in IS has used Triandis' behavioural framework to examine system use. However, longitudinal examination of phenomena, as recommended by Triandis (1975) and others has not received adequate attention. For instance, although Cheung and Limayem (2005) investigated the development of the relationship between intention and usage, and the moderating role of habit in two different time periods, they did not assess whether the effects of habit changed significantly over time. As a result of this gap in the IS literature, there is limited understanding of how the influence of predictors of CSU changes over time.

This study provides longitudinal theorising of the relationships between CSU and its two key antecedents of continuance intention and habit. Static effects of these antecedents are well-studied in the literature, thus we are brief in our justification of these relationships. We examine how these relationships evolve temporally. We provide an alternative perspective – different from that proposed in the current IS literature – on the static interaction effect of intention and habit on CSU. We further examine the temporal effects of this interaction on CSU (see Figure 1 for our research model).

2.3.1. Research hypotheses

Prior research in psychology suggests that intentions are self-instructions to perform particular behaviours to obtain certain outcomes (Triandis, 1980). In other words, intentions are functional and goal-directed

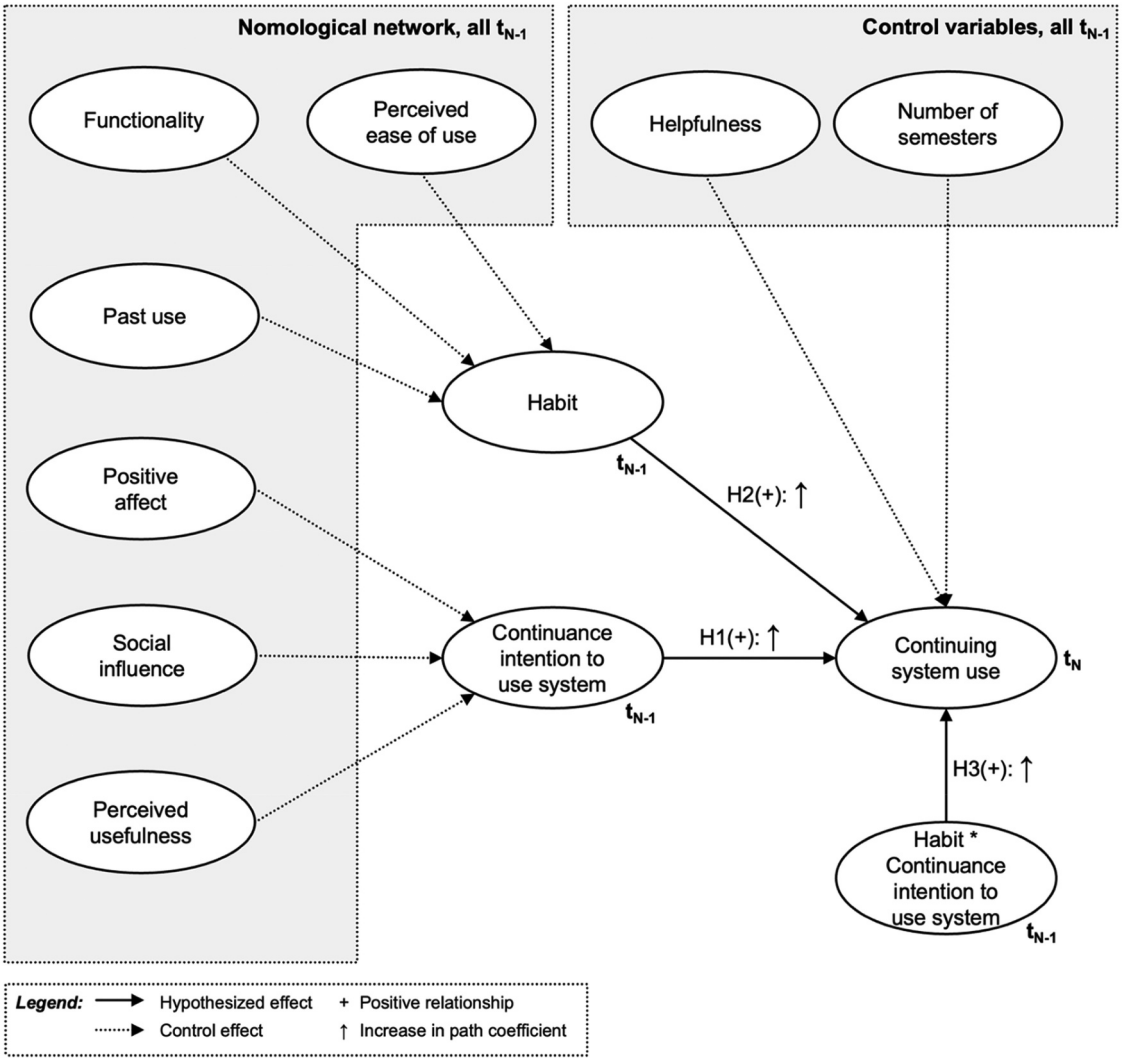

Figure 1. Research model.

(Ortiz de Guinea & Markus, 2009), and provide a reflective pathway to act (Ferratt et al., 2018). Intentions also resemble plans about how to act; forming a behavioural intention signals the end of the deliberation and indicates how much effort one is willing to exert, in order to achieve desired outcomes (Webb & Sheeran, 2006). Thus, intention can be construed as an indicator of the willingness of individuals to enact a behaviour. Extant IS research suggests that continuance intention to use a system signifies a deliberate and cautious decision made by the user and is a strong predictor of actual use (Limayem et al., 2003, 2007). Hence, the continuance intention to use is expected to be positively related to CSU.

However, how important a role does intention play on CSU from a longitudinal perspective? Researchers suggest that the central role afforded to the continuance intention in the literature, albeit justified in the cross-sectional analyses or early-stage use of the system, is not always defensible. A measured and conscious response to a system signal that use behaviour is new, the user is not fully familiar with the system, and has not integrated it in her work practices. However, when a behaviour is performed for a period of time, it may no longer be under absolute control of the user (Limayem et al., 2007; Ouellette & Wood, 1998; Venkatesh et al., 2012), possibly lowering or obviating the need for a conscious decision before system use. Further, prior research suggests that intentions may have limited power to predict IS use due to environmental impediments and barriers, which can prevent the completion of the behaviour (Ahuja & Thatcher, 2005; Gardner, 2015). Reinforcing these views, researchers have found that use behaviours of experienced users are less likely to be impacted by intention than those of new users (Limayem & Hirt, 2003).

Although extant IS research seems to have formed a consensus that continuance intention loses significance over time, we argue for the need for nuanced theorising. We posit that utilitarian use of a volitional system, when the focal system serves as one alternative to get tasks accomplished, requires intention to be continually present on the part of users to enact behaviours.

The use of a new system is fraught with uncertainties and requires significant focus, time, and adjustments

for successful integration, thus intention is clearly critical in the initial stages. Over time, as individuals become more familiar with the system and have a better sense of its capability, they can further assess if it enables them to complete tasks effectively and efficiently. Users also form rational beliefs about continued usefulness and benefits, as also adjustment and transition costs, as they use the system (H.-W. Kim & Kankanhalli, 2009). Such calculations are likely to play an important role in users' continued use of a volitional, utilitarian system, because alternatives are available for them to consider. Baptista (2009) argues that users' perception of the ability of the system to perform tasks enhances their motivation to use the system and the actual use of the system. This effect is also reflected in the empirical results of an early study from the IS literature that found that the impact of intention on usage increases over time. The author argues that this result could be observed, because as the users gain experience with the new system, they are better able to assess its efficacy on their work (Szajna, 1996). Consequently, if a user has a choice of systems to get tasks completed, then despite the length for which he may have been using a particular system, he is likely to make a calculation about its protracted use and the importance of intention is likely to increase when it comes to predicting use. This is because system use is for utilitarian purposes and the user has to intend to use it rather than using it distractedly or for entertainment. The effect of intention may strengthen because the novelty of the system wears off over time and hence the user has to indeed intend to use the system in a goal-directed manner. Finally, as users use the system, they have a better sense of its efficacy, providing further motivation of intention to use (Szajna, 1996). Thus:

H1: *The positive effect of continuance intention on continued volitional use of a utilitarian system strengthens over time.*

Habit has emerged as a second important mechanism to explain CSU. Habit reflects the extent to which people tend to perform IS use behaviour automatically under stable contexts and cues. Habit enables an individual to be in a state of perpetual readiness, lowers distractions and prevents adoption of other, less efficient courses of action (Verplanken & Aarts, 1999), which allows the person to accomplish goals and tasks more efficiently. Prior research argues that habit develops after a period of experience on and repetition with the system (Limayem et al., 2007; Venkatesh et al., 2012). Over time, as habit becomes established, and the behaviour becomes habit-driven, an individual needs to expand progressively lower amounts of cognitive effort to evaluate the behaviour or to deliberate whether to perform the behaviour. Use behaviour, thus, becomes routine and automatic and is driven more by consistent cues that may trigger use (Venkatesh et al., 2012). Several studies have demonstrated that habit is a significant predictor of actual system use (Limayem & Hirt, 2003; Limayem et al., 2007; Venkatesh et al., 2012).

As use behaviour becomes automatic, particularly in stable contexts, where the situational cues trigger automatic invocation of the behaviour,1F[2] well-learned action sequences are initiated and repeated without much conscious intention (Ortiz de Guinea & Markus, 2009). An IS behaviour that is performed regularly and for a significant amount of time, such as web browsing, or checking email, is likely to result in stronger habits than those performed relatively rarely, or for short durations, such as selecting health insurance plans, or configuring a system for personal use. Over time, as people keep performing the behaviour frequently, it is likely that the associated cognitive processes will be increasingly automated and involuntary, and the relationship between the habit and system use will be strengthened.

In the context of volitional use of a utilitarian system, leveraging the potentials of this well-learned action sequences, and routinisation of certain behavioural process is especially important for two reasons. First, unlike in mandatory use situations, where users must use a certain system, potentially because it is the only option provided by a company, in voluntary use situations, users can choose which system to use. Consequently, the risk of losing users to another system is higher. Second, users do not rely on utilitarian systems for entertainment or other more joyful activities that can create emotional bonds. Rather, users of utilitarian systems seek to accomplish certain tasks or to achieve pre-defined goals. Consequently, users have an interest in continuously assessing whether novel systems are available that might support them better, and thus might switch from one utilitarian system to another. To counter this increased risk of losing existing users, building habit creates an additional barrier that grows in importance over time, hindering users to switch systems due to the routines they built with the current system. Hence:

H2: *The positive effect of habit on continued volitional use of a utilitarian system strengthens over time.*

We next consider the interaction effect of continuance intention to use the system and habit on CSU. Extant research suggests that habit limits the predictive power of continuance intention on the actual use behaviour, because the repetition of behaviour lowers the importance of intention and the use behaviour is triggered automatically based on situational cues (e.g., Limayem et al., 2007). The key rationale is that after habits form, the control for the behaviour is largely assigned to environmental stimuli and the behaviour

is contextually cued, without any significant deliberation or thought.

Although, IS researchers seem to have settled on the notion that habit negatively impacts the relationship between continuance intention and CSU, the reference literature in psychology is more nuanced. The psychology literature suggests that intention and habit can jointly determine behaviour (Ouellette & Wood, 1998), and the joint influence of habit and the intention of the individual to perform a behaviour depends on the individual's previous experience (Triandis, 1977). Sometimes, intentions conflict with habits, yet at other times, the two reinforce each other's impact on behaviour (Ouellette & Wood, 1998; Wood & Neal, 2007). The literature further suggests that interactions between intention and habits entail a rich spectrum and should be examined in detail, taking into consideration the context of the use behaviour (Bruijn et al., 2012; Gardner et al., 2015; Verplanken & Orbell, 2003). Gardner (2015) suggests that the notion that the entire behaviour can be completely automated and performed without any control or intention is unlikely and does not match the subjective experience of people. In other words, even when a user has been using a system habitually, continuance intention may remain an important antecedent of system use.

Habits conflict with intentions in situations where people attempt to change or modify an existing habitual behaviour, because then habit is in direct disagreement with the deliberate intention to change. For example, these situations are likely to arise when people try to quit social media after several years of use. In such cases, the impulsive response arising from habit is typically easier to access for an individual and tends to dominate the reflective response generated by intention.

Barring such conflicts, however, intentions and habits are likely to reinforce the impact of each other on behaviour. Positive interaction effects between habit and intention have been found in many recent psychology studies (Bruijn et al., 2012; Gardner et al., 2015; Gardner, 2015; Rhodes & Bruijn, 2010). Strong correlation and positive interaction between habit and intention is insightful because habits form through repetition of intentional actions. In particular, behaviours that are involved require strong intention/motivational and habit/automatic components simultaneously rather than entailing a trade-off (Bruijn et al., 2012). Thus, when intentions and habit correspond, people are more likely to engage in a behaviour. Accordingly, if a system user's intention to use the system and the use habit do not directly conflict with each other, then the two are likely to have a reinforcing impact on her system use.

In the context of volitional use of a utilitarian system, one can argue that habit alone will probably not trigger usage. Rather, intentional cues, for instance an upcoming task that needs to be done, are likely to create a situation in which the use of a corresponding utilitarian system is necessary. Habitual cues then foster the use of the system that has been used beforehand. Consequently, in these situations, intention and habit correspond and jointly lead to continued system usage, and the influence of this joint mechanism is likely to increase over time, as more such situations are experienced. Thus:

H3: *The positive relationship between the interaction effect of habit and continuance intention, and continued volitional use of a utilitarian system strengthens over time.*

Although our focus is on exploring longitudinal effects of intention, habit, and their interaction on CSU, we include several control variables in our research model. We control for perceived helpfulness of the system because prior studies show that facilitating conditions impact system use (e.g., Limayem & Hirt, 2003; Venkatesh et al., 2012). In addition, we control for the number of semesters a student was enrolled at the university. Students only have a temporary relationship with the university, so those who have completed more semesters are closer to leaving the university, which might impact system use.2F[3]

3. Research methodology

3.1. Study design & data collection

We designed a longitudinal study to estimate our research model. We examined the use of a HEIS at a European public university, with about 25,000 students. The goal of the newly implemented HEIS was to combine the functionalities of all previous systems, so students could coordinate their academic and social activities. The new system allows students to organise courses; register for examinations; and view course schedules, test results, and a variety of event calendars. Uniform, yet flexible and adaptable user interface implemented in the system makes it possible for students to customise the content.

The system underwent extensive testing and modification before it was fully implemented at the university. Prior to and during the launch of the new HEIS, the university organised several offline events to inform students about the new system and its advantages. Furthermore, all students received an email promoting the new system, and inviting them to try it. Finally, the new HEIS is now the default that is presented to incoming students during the introductory weeks, however, the old systems are still operational, and students are free to continue using them.

Shortly after the new system was made available, we promoted our study via email to all university students. Interested students had the opportunity to register electronically to participate in an online survey. The survey was conducted online to reach a large target population. To incentivise survey participation, students were entered in a lottery for amazon vouchers. We emphasised that only survey participation and *not* the actual use of HEIS was rewarded to facilitate natural usage behaviour. Survey data collection started two weeks after the system was promoted via email. Survey data was collected at three additional periods. The interval between each of the data collections was three weeks. For each measurement time point, registered respondents received a personal email invitation to participate in the online survey. Respondents had two weeks to answer the survey from the date of the email invitation. Furthermore, they had the option to be removed from the mailing list at any time.

3.2. Questionnaire development and construct operationalization

Study constructs were operationalised using existing validated scales that were adapted to the context of our study. Appendix B provides details, such as items used for construct operationalisation and sources of items. Items were randomised for each participant to avoid the possibility of order effects. All English scales were translated into the local language by a dual language speaker to avoid measurement errors through translation mistakes. The translation was approved by both local language and English-speaking researchers as being equivalent. We further took several measures to minimise the occurrence of common method bias (please see Supplementary material).

3.3. Data preparation and sample description

At the beginning of the study, at time t_0, 1062 students registered to participate and 335 continued through time t_4. Table 3 reports the number of respondents for each survey (t_1- t_4). On average, students in our sample are about 25 years old (Median = 25.0, Mean = 25.48) and represent males and females almost equally. Their average tenure at the university is about four study semesters (Median = 4.00, Mean = 4.40), ranging from 1 to 20 semesters.

Table 3. Details on the final number of respondents.

	Measurement time point			
Survey details	t_1	t_2	t_3	t_4
Number of fully completed surveys	612	455	347	335

Table 4. Final sample size used in each model.

	Model 1 (t_1& t_2)	Model 2 (t_3& t_4)
Sample size	378	281
Matching Respondents	249 (65.9%)	249 (88.6%)
Unique Respondents	129 (34.1%)	32 (11.4%)

We followed the approach used in Limayem et al. (2007) for model development, and lagged antecedents of CSU by one time period. This step affects our sample size, because we can only analyse participants who provided data for the two consecutive time points necessary to build our model, but it facilitates causal interpretation. Our 4 time points could have allowed us to build three models, but in the interest of depicting the highest contrast between time periods and robust and stable estimates, we present results of only two models in this paper. This temporal separation between models 1 and 2 allows sufficient elapsed time after the use behaviour starts, enables the user to form new habits (Lally et al., 2010), and allows us to depict the highest contrast and obtain robust and stable difference estimates. Table 4 shows the final sample size used for these two models.[4]

4. Analysis and results

We employed partial least squares structural equation modelling (PLS-SEM) using SmartPLS 3.3.5 (Ringle et al., 2015) to analyse our data. We performed data analysis in three stages. First, we estimated both model 1 and model 2 to assess psychometric properties of our study constructs at different time periods. Second, we assessed the significance of the structural paths for both models using nonparameteric bootstrapping with 5,000 subsamples to examine the relationships between constructs illustrated in Figure 1. Finally, we compared models 1 and 2 using a modified version of the permutation approach for MGA to assess temporal effects (see Table D7 in Appendix D). In addition, we further tested for measurement invariance over time to verify that constructs are measured similarly, and that changes in the relationships between constructs reflect true relational differences, not a manifestation of when constructs were measured (Ployhart & Vandenberg, 2010, for further details, see Appendix E). The standard permutation approach, usually employed in PLS when using MGA (e.g., Chin & Dibbern, 2010; Sarstedt et al., 2011) and measurement invariance testing for composites (MICOM, Henseler et al., 2016), assumes sample independence, which our data do not support because respondents are sampled across all time periods. Thus, we extended the permutation approach to account for paired-samples (please see Appendix F for further details). We further used the marker variable approach to test for the occurrence of common method bias (please see Appendix C for further details)4F[5].

4.1. Evaluation of measurement models

All the constructs specified in our research model are reflective. We analyse construct reliability and discriminant validity, by assessing the lowest indicator loading, the composite reliability (ρ_a), the average variance extracted (AVE), the heterotrait-monotrait ratio (HTMT), the heterotrait-monotrait inference criterion ($HTMT_{inference}$), and the Fornell-Larcker criterion (Hair et al., 2014; Henseler et al., 2015). The detailed results for all quality criteria can be found in Appendix D. To summarise, all item loadings for all constructs are higher than 0.7, ensuring indicator reliability and convergent validity. Composite reliability ρ_a and AVE are higher than 0.7, and 0.5 for all constructs. All but one5F[6] HTMT criterion scores are below the threshold of 0.9, the $HTMT_{inference}$ criterion is below 1, and the square root of the AVE of all constructs is higher

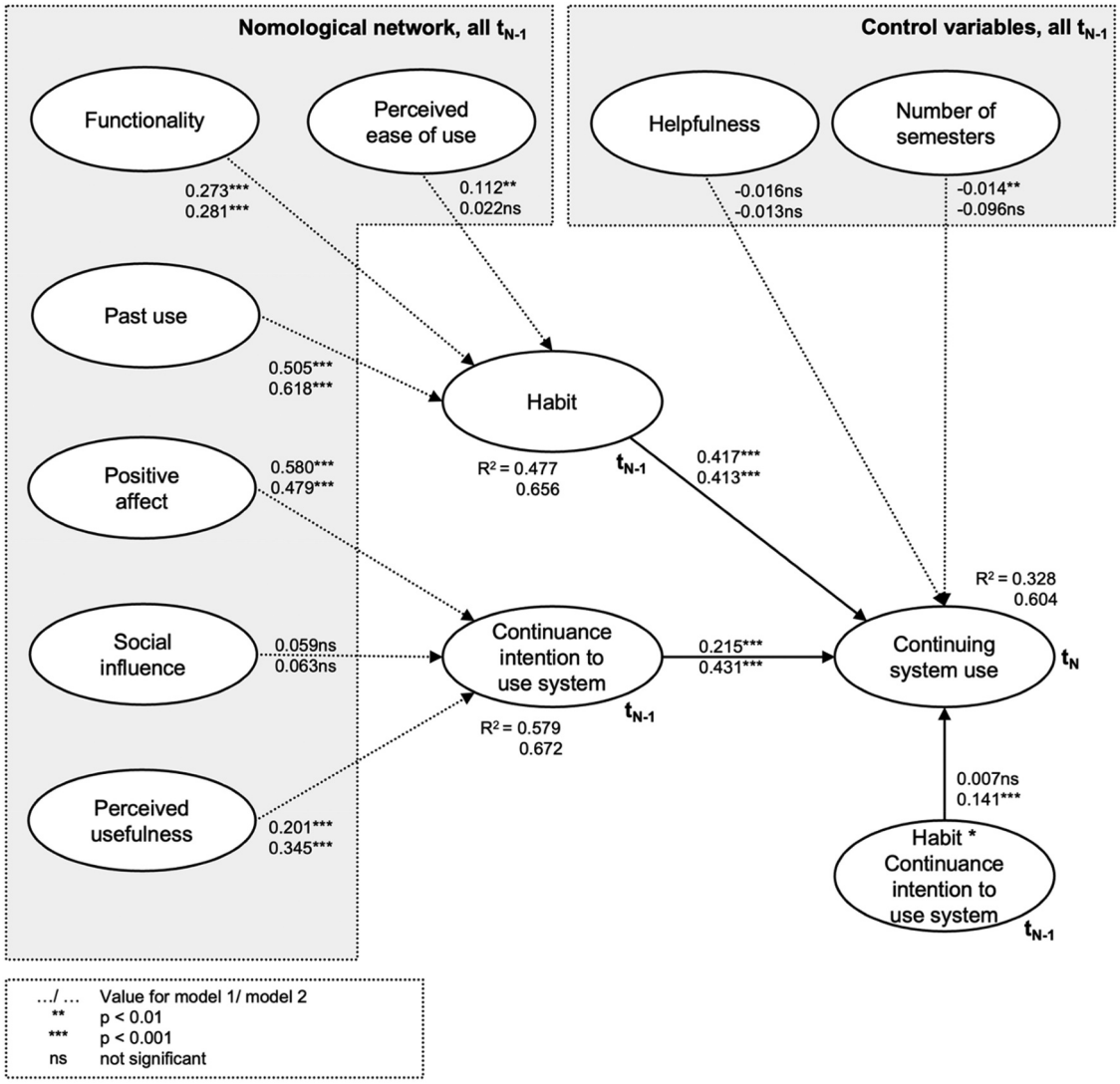

Figure 2. PLS Estimation results.

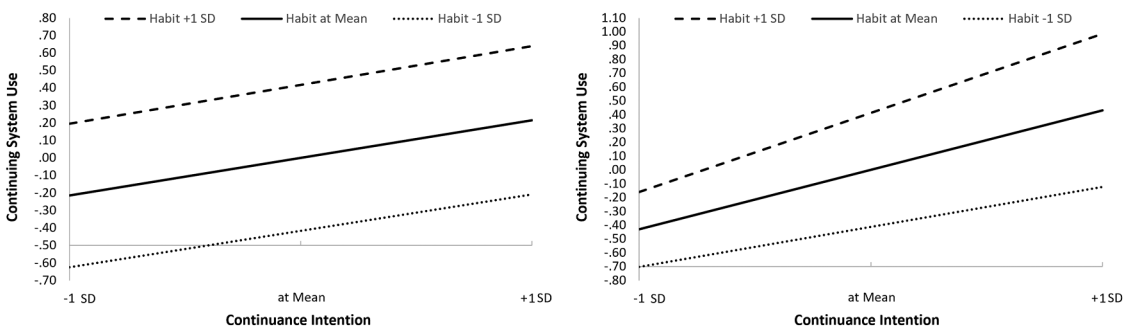

Figure 3. Plots of the interaction effects between habit and continuance intention of CSU (model 1 on the left side, model 2 on the right side).

Table 5. Results of the PLS-MGA using the permutation approach.

Hypotheses		Model 1		Model 2		Model 2 – Model 1		Hypothesis assessment
		Path coefficient (PC)	p-Value	PC	p-Value	Δ PC	p-Value	
H1(+): ↑	CI → CSU	**0.215**	0.001	**0.431**	<0.000	**0.216**	0.037	**supported**
H2(+): ↑	Habit → CSU	**0.417**	<0.001	**0.413**	<0.000	−0.004	0.969	**not supported**
H3(+): ↑	Habit*CI → CSU	0.007	0.849	**0.141**	<0.001	**0.135**	0.013	**supported**

Significant effects on $p < 0.05$ in **bold**; Table D7 in Appendix D provides the full results including confidence intervals. The control variables have been excluded from this table due to brevity.

than any correlation with another construct (Fornell-Larker criterion), indicating the presence of discriminant validity.

4.2. Evaluation of structural model

We next estimate structural models to examine the dynamic relationships posited in our research model. We assess the presence of collinearity using the variance inflation factor (VIF) and condition index. All VIF values are below 5.0 (highest is 4.09; for details see Table D6 in Appendix D), indicating that significant collinearity problems are not present (Hair et al., 2014). The highest condition index is 4.27, below the range of 5–10 which indicates weak dependencies, and far below 30 which indicates problematic collinearity (Belsley et al., 1980). The R^2 value for our focal construct CSU is 0.328 for model 1 and 0.604 for model 2. The R^2 values for CI and Habit are between 0.477 and 0.672 in both models. The SRMR values for models 1 and 2 are 0.092 and 0.089 respectively, suggesting that our models fit the data well. Finally, we examine our focal hypotheses by assessing the path coefficients' strength and their significance in each model (Figure 2) using bootstrapping. We find significant results for both of our focal study constructs (i.e., habit and continuance intention) in both the models and for the interaction of habit and continuance intention in the second model. Figure 3 depicts the simple slopes from the interactions in both models. All lines are almost parallel in model 1 (on the left; t1&t2; no significant interaction), suggesting that the effects of habit and continuance intention are simply additive. However, in model 2 (on the right, t3&t4) we can clearly see the positive interaction such that the effect of continuance intention on the continued system use is especially strong with high levels of habit.

4.3. Evaluating temporal relationships between continuing system use and antecedents

To assess the nature of evolving relationships posited in our dynamic research model, we perform a multiple group analysis (PLS-MGA). We compare the differences in path coefficients between models 1 and 2, because we believe that a temporal separation is necessary to fully study the impact of habit, intention and their interaction on CSU.

Traditional PLS-MGA such as the commonly used non-parametric bootstrapped-based PLS-MGA or permutation approach assume independent samples (e.g., Chin & Dibbern, 2010; Sarstedt et al., 2011). However, our longitudinal dataset comprises dependent samples at each time point t, where the same respondents are surveyed across all time points with some non-response. Thus, most of the respondents at each time point t_i are also included in the sample for time t_{i+1}. This entails the need for a dependent sample test for differences in the parameters. A candidate for such an improvement is the permutation approach. We developed an extension of the traditional permutation approach for analysing dependent samples (please see Appendix F for further details).

Table 5 shows the path coefficient estimates for models 1 and 2 and the differences between these models over time using the modified permutation approach. Our results suggest that continuance intention and habit are significant in both models 1 and 2. However, while the impact of intention on HEIS use increases over time, supporting H1, the impact of habit does not change statistically over the two time periods. Thus, we do not find support for H2. We also find that the joint effect of continuance intention and habit is insignificant in model 1, but significant in model 2; this difference is statistically significant, thus providing support for H3.

5. Discussion, limitations, and implications

Continued system use remains a popular and consequential research topic among IS scholars (e.g., Burton-Jones et al., 2020; Ferratt et al., 2018; Lin et al., 2021; Negoita et al., 2018; Thatcher et al., 2018; Tong et al., 2017; Trieu et al., 2022; Zhang & Venkatesh, 2017). Despite a significant amount of research, our understanding of IS use patterns and use over time is limited (Bagayogo et al., 2014; Ortiz de Guinea & Webster, 2013). In order to extend this literature, Benbasat and Barki (2007) made an impassioned call for IS research to advance understanding of the dynamic process through which evaluations and behaviour change as users gain experience with a system. Zheng et al. (2014) have also made

a similar appeal. In this study, we heed to these calls and extend the continued IS use research by examining how habit and continuance intention impact use longitudinally, both in isolation and in combination. We examine an IS use context which is common in practice but has been underexplored in IS research.

Consistent with a subset of IS use studies, we examine habit and continuance intention in the same research and jointly assess their temporal impacts on CSU. However, we highlight the need to consider the specific IS use context when theorising about habit and continuance intention and their effects on CSU. Utilising the context of our study – volitional use of a utilitarian system when alternatives are present – we build on TIB to hypothesise and examine a reinforcing effect of habit and continuance intention on CSU, which is expected to increase over time. Furthermore, we hypothesise that the impact of intention on system use doesn't diminish but is rather strengthened. Longitudinal theorising and analysis enable us to examine the relationships between intention, habit, their interaction and CSU from a dynamic perspective, providing deeper insights into changes in relationship strengths over time and helping establish the causality between constructs.

With validation for two out of three hypotheses, our research model found good support from the data. All three of our key results are new in the IS literature and provides insights that are not available from extant research because the IS use context examined in this study is different. First, in contrast to the dominant thinking in the IS literature, continuance intention does not become less significant over time in every use context. Continuance intention can be significant in initial stages of utilitarian system use, and its impact can strengthen over time. Second, IS habit and automatic behaviour do not always become more significant for system use with time. And, third, IS habit and continuance intention can interact to reinforce each other's impact, even if the effect is insignificant in the initial stages. In other words, their joint effect on CSU can be positive and impactful as time progresses. The critical distinction to emphasise is that habit and continuance intention are not in conflict in the context of our study, whereas much of IS literature has focused only on contexts in which both are in conflict. It is important to note that the interaction effect is insignificant in Model 1 (see Table 5). This could be because users may not have had sufficient prior experience with the system, which is important for habit and intention to jointly impact behaviour (Triandis, 1977). Additionally, in the initial stages, users may not have formed concrete intention to use the system. Thus, the insignificant impact of interaction of intention and habit on CSU in Model 1 is not completely unexpected.

We did not find support for Hypothesis H2. We notice that habit is a significant predictor in both early and late stages of system use, however its impact does not change statistically during the two time periods. A potential reason for this result is that the usage situation and triggers changed frequently for students. Prior research suggests that constancy of usage situation is important for the impact of habit on use behaviour to get enhanced (Ouellette & Wood, 1998; Wood & Neal, 2007). Our study participants could use the HEIS in different settings, at different times and in vastly different manners to accomplish a variety of goals. For instance, they could be at student housing facilities, their family homes, libraries, classrooms, in public transit and other places while using the system. They could also use the system using computers or mobile phones. The trigger of use could be course-work-related, exam-related, or schedule-related. The fact that usage situation and triggers change may limit the impact of habit from strengthening over time.

5.1. Limitations and future research

Despite careful attention paid to the design and execution of the study, our study has limitations, which provide opportunities for further research on CSU. Our study is focused on studying continued volitional use in a utilitarian context where students use the system to accomplish certain tasks. Systems can also be designed for hedonic or for both utilitarian and hedonic purposes. Our results may not apply to these latter two types of systems. Future research can extend our work in these contexts.

Second, use measures analysed in the study were self-reported. Due to privacy concerns, it was not possible for us to confirm self-reported use measures with system-logged measures. Prior research has suggested some limitation of self-reported measures because these may differ from system generated objective measures (Szajna, 1996; Venkatesh et al., 2008). Because we were not granted access to the actual use data, we recommend that researchers attempt to obtain such data from organisations to study the differences that may arise. Additionally, we do not examine whether the students use the new HEI effectively and notice any improvement in their task performance. Future research can examine effective use of utilitarian systems by individuals in a volitional manner when alternative systems are available to get tasks accomplished.

Third, we use survey data as the only source of data for our study. This approach is consistent with prior related research and our research interests. Given our longitudinal research interest, we focused on designing a rigorous multi-wave quantitative study. However, additional analyses using qualitative data collected through interviews with study participants

could have enriched our quantitative results and provided an even more detailed picture. We consider this as an opportunity for future research.

Finally, we collected data from university students who used a HEIS voluntarily. Scholars examining continuing system use have strongly defended their use of student subjects (Limayem et al., 2007). However, researchers may wish to examine longitudinal use of a system in a "real-world organisation".

5.2. Implications for practice

From investment justification and impact perspectives, continued use of systems by users is vital for organisations (Straub & Del Giudice, 2012; Trieu et al., 2022), yet a nuanced, longitudinal examination of the phenomenon, when more than one system can be used to accomplish tasks, is lacking in the literature. It is not uncommon for users to abandon newly implemented systems in favour of other alternatives (Boudreau & Robey, 2005) and not achieve their intended impacts (Limayem et al., 2007). Our results suggest that under such IS use circumstances, continuance intention and habit are separately important for CSU. From our results, we also notice that in general, habit is more strongly related to CSU than continuance intention, but in the earlier phases, habit has considerably higher impact on CSU than continuance intention. These results indicate that from the perspective of increasing systems use, both habit and continuance intention need to be emphasised during both early and later stages of usage. Furthermore, because the intended effects of continuance intention and habit are not contradictory, our result of positive interaction effect between the two antecedents during later stages of system use suggests that even after an individual gets habituated to use a system, it may be prudent to underscore both habit and intention to use.

We caution managers against assuming that as users get accustomed to a system, their intention to use it will cease to play an important role. This is particularly true for volitional use of a utilitarian system when other alternatives are present to get the same tasks accomplished. In the usage scenario mentioned above, users' motivation and intention will continue to be an important factor for system use, beyond the period immediately after the introduction of the system. To enhance users' motivation and intention, managers should consider reminding users about their outstanding tasks, their prior accomplishments in terms of completing tasks, emphasise the usefulness of the system, and monitor if users experience difficulty in completing tasks or abandon their efforts. To encourage habitual use of the system, managers should consider enhancing the functionality of the system to make sure that users can accomplish more tasks, while keeping the system largely free of errors. Further, managers should take steps to make the system easier to use by making the navigation intuitive and understandable and allowing users to access the system from anywhere on multiple devices and platforms (e.g., web and mobile; Android and iOS).

5.3. Implications for theory and research

This study provides several key implications for theory and research. First, our results indicate that in contrast to much of the argumentation and evidence in the IS literature, in the context of volitional use of utilitarian systems with other alternatives present, continuance intention remains important in later stages of system use. In fact, its importance increases over time. The key insight here is that if a person is using a volitional system for goal-directed purposes to get tasks accomplished and the related behaviour is involved, perhaps containing multiple steps, then the use of this system must be intended. In other words, deliberate reasoning and reflection, and working out details such as plans, procedures, actions and termination of behaviour are important, irrespective of whether the system is new to the user or if she has used the system. In fact, intention, plans and reflective pathway may increase in significance because the system use is volitional, with other alternative systems in use and the prevalence of distractions once a user engages with the system. We believe that such nuanced considerations of different IS use contexts are important for further extending the mature literature on system use. We believe this is a key finding in our research, and we would urge IS researchers investigating CSU to judiciously delineate the use context (e.g., utilitarian vs. hedonistic; single system vs. multiple systems; volitional vs. mandatory systems) and theorise the relationship between intention and CSU accordingly.

Second, our results suggest that habit and CI can have reinforcing impacts on each other. Indeed, prior research in psychology has suggested that CI, habit and behaviour can be related to one another in dynamic ways (Ouellette & Wood, 1998). However, such investigations are largely absent from the IS literature, with most of the work hypothesising negative moderating effect of habit on the relationship between CI and IS use. Theorising this dynamic interaction in different system use contexts and empirically evaluating theoretical claims can be a fruitful area for IS research for many years to come. We believe that IS researchers can significantly push the boundary of knowledge in IT use and longitudinal inquiries if they theorise how the joint effect of habit and continuance intention can temporally influence system use by considering the specific use context. We believe that three key considerations will be the purported purpose of the system (e.g., utilitarian, hedonistic or both), the presence of a single or multiple system(s),

and whether the intention to use the system and use habits correspond or conflict with each other.

Third, through theoretical arguments that explicitly consider the temporal/dynamic nature of systems use and use context, and through a longitudinal research design, this paper reveals results that run counter to established wisdom in the IS literature. We posit that cross-sectional research designs used in a majority of IS continuance literature (Cheung et al., 2000; Lin et al., 2021; Thompson et al., 1991), although valuable, needs to be supplemented with longitudinal designs. This paper was able to detect the dynamics of relationships between intention, habit, and their interaction over time precisely because of our longitudinal theorising and longitudinal research design. We highly recommend that future research undertake such endeavours in a variety of use contexts.

Finally, we wish to revisit the fact that the reported study examined a HEIS in a university setting, using undergraduate students. What are the boundary conditions of our results? We firmly believe that our results can be extended beyond HEIS. We emphasise that the key context that this study examined was the volitional use of a utilitarian system when other alternatives are present to get the same set of tasks accomplished. Our argumentation and hypothesising are based on well-established psychology theories without explicit emphasis on learning systems or university setting or undergraduate students, and thus we expect the results to transcend. Organizations often engage in parallel system implementation efforts, where users can use multiple systems to get the same tasks accomplished. Organizations may not mandate the use of any of these systems. These settings are good candidates for replicating our results and extending the current research in IS use.

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Notes

1. SAP has promised support for older versions until 2025, although it has deliberately kept the timeline and product map vague. Industry professionals expect organisations to be able to use older enterprise technologies in parallel with SAP S4/HANA beyond 2025.
2. It is important to note here that although constructs, such as habit, experience and past use appear to be the same, prior research has clearly distinguished them (Limayem et al., 2007; Venkatesh et al., 2012).
3. We would like to thank an anonymous reviewer for this suggestion.
4. Based on a reviewer suggestion, we excluded responses that fail attention checks. Specifically, we exclude: 1) respondents who fail the majority of trap questions (i.e., questions that asked the respondents to click on a specific response category, and 2) "straightliner" who clicked more than 90% of the time on the same response category. However, the main findings are robust when not excluding these respondents.
5. We would like to thank an anonymous reviewer for recommending this approach.
6. The two constructs that have a higher HTMT than 0.9 are past and current system use, that is, the same constructs measured at different time points. In such a case, discriminant validity is not required as we are measuring the same construct.

Disclosure statement

This analysis uses the SmartPLS 3 statistical software (https://www.smartpls.com/); Jan-Michael Becker acknowledges that he has a financial interest in SmartPLS.

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